What is claimed is:

~~1. A microscope~~ adapted for viewing an object positioned on a slide, comprising:

(a) one and only one lens; and

(b) a structure adapted to support the lens and to position the object a specific distance from the lens, the structure containing substantially no openings between a viewer's eye and the object being viewed and at least partially enclosing the object being viewed when the microscope is in use in order to minimize the possibility of injury to the viewer's eye.

2. The microscope of claim 1, wherein the lens comprises an aperture optimized lens.

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3. The microscope of claim 1, wherein the structure substantially encloses the object being viewed.

4. The microscope of claim 1, wherein the structure comprises a hinged box having four sides, a top, and a bottom, wherein the top is adapted to support the lens and the bottom adapted to support the object.

5. The microscope of claim 1, wherein the structure comprises (i) an upper portion defining an optimized aperture containing the lens and (ii) a lower portion defining a surface adapted to position the object.

6. The microscope of claim 1, further comprising

(i) an optimized aperture defining the lens; and

(ii) a positionable slide holder;

wherein the positionable slide holder positions the object for viewing substantially parallel to the optimized aperture.

7. The microscope of claim 1,

wherein the lens has an optical axis; and

further comprising a positionable slide holder;

wherein the positionable slide holder positions the object for viewing substantially perpendicular to the optical axis of the lens.

8. The microscope of claim 7, wherein the positionable slide holder comprises a slide holding portion and a slide positioning portion.

9. The microscope of claim 8, wherein:

(i) the slide holding portion is adapted to hold a slide and comprises a first magnet; and

(ii) the slide positioning portion comprises a second magnet on the exterior of the structure;

wherein movement of the slide positioning portion causes the slide holding portion to track the movement.

10. The microscope of claim 8, wherein

(i) the slide holding portion is adapted to hold a slide and is at least partially surrounded by the structure; and

(ii) the slide positioning portion is a handle that extends at least partially outside the structure;

wherein movement of the slide positioning portion causes relative movement of the slide holding portion.

11. The microscope of claim 8, wherein the slide holding portion has a slide gripping frame section for receiving a microscope slide.

12. The microscope of claim 8, wherein the slide positioning portion comprises a handle section having a long axis adapted to provide linear translation in the direction its long axis and rotation about a fixed point.

13. The microscope of claim 7, wherein the positionable slide holder comprises:

(i) a frame having a length and a width slightly larger than a microscope slide, the length and width forming a base adapted to receive a slide,

(ii) the frame having one or more raised edges approximating the thickness of a microscope slide,

(iii) the one or more raised edges having one or more catch surfaces adapted to engage upper surfaces of a microscope slide in order to retain the microscope slide in the positionable slide holder; and

~~(iv) a handle extending~~ from the frame for manipulating the position of the frame.

14. The microscope of claim 1, further comprising:

(i) an object positioning device; and

(ii) a locking apparatus adapted to lock and hold the object positioning device in position relative to the structure.

15. The microscope of claim 14, wherein the locking apparatus comprises a clamp adapted to at least partially restrict translational motion or rotational motion or both of the object positioning device with respect to the structure.

16. The microscope of claim 14, wherein the locking apparatus is selected from the group consisting of magnets, wedges, screws, levers, ratchets, gears, clamps, and cams.

17. The microscope of claim 14, wherein the locking apparatus comprises

(i) a cam structure; and

(ii) a clamp,

wherein tightening of the cam causes the clamp to secure the object positioning device.

18. The microscope of claim 14, wherein the strength of the lock provided by the locking apparatus is adjustable.

19. The microscope of claim 1, further comprising a plurality of apertures on the structure, wherein the apertures may be maneuvered for various viewing effects.

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20. The microscope of claim 19, wherein the apertures are on a carrier that is a rotatable disk or a sliding member.

21. The microscope of claim 19, wherein the plurality of apertures comprises apertures having features selected from the group consisting of various diameters, filters, colored filters, polarizing filters, Rheinberg illumination filter and stop assemblies, dark field illumination stops, condenser lenses, illumination control elements, and any combination thereof.

22. The microscope of claim 1, further comprising an illumination controlling system.

23. The microscope of claim 22, wherein the illumination is provided by a natural light source or an artificial light source or both.

~~24. The microscope of claim 23, wherein the light source comprises a source selected from the group consisting of sunlight, firelight, incandescent light, fluorescent light, electrically activated phosphors, photographic flash, solid-state light production devices, LEDs, transmitted light, reflected light, and any combination thereof.~~

25. The microscope of claim 22, wherein the illumination controlling system comprises one or more light admitting apertures in the structure.

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26. The microscope of claim 25, wherein the structure comprises

(i) a top cover supporting the lens; and

(ii) a bottom cover providing the one or more light admitting apertures.

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27. The microscope of claim 1, further comprising a device for capturing and reproducing an image of the object being viewed.

28. The microscope of claim 27, further comprising a multiplicity of illumination angles, provided either sequentially or simultaneously, to produce stereoscopic image pairs.

29. The microscope of claim 1, further comprising a focusing system adapted to focus an image of the object for a viewer by altering the spatial relation of the lens and the object being viewed with respect to one another.

30. The microscope of claim 29, wherein the focusing system comprises a mechanical connection selected from the group consisting of a focus ring, a screw-jack, a scissors jack, a rack and pinion, a cam and follower mechanism, a simple lever, a compound lever, a pantographic linkage, a four-bar linkage, one or more inflatable vessels or bladders, one or more pistons and cylinders, a cable and pulley arrangement, motor driven actuators, piezoelectric actuators, inchworm drives, an electromechanical mechanism, a pneumatic mechanism, a hydraulic mechanism, a piezoelectric mechanism, and any combination thereof.

31. The microscope of claim 29, wherein the focusing system comprises:

(i) a stage adapted to display a slide, wherein the slide can be positioned on the stage without altering the position of the slide with respect to a focal plane of the lens; and

(ii) a mechanical connection adapted to move the stage in relation to the lens.

32. The microscope of claim 31, wherein the structure further comprises a tension mechanism between the stage and the mechanical connection in order to provide contact between the stage and the mechanical connection.

33. The microscope of claim 32, wherein the tension mechanism provides stabilization to resist displacement of the stage in a plane substantially parallel to the focal plane of the lens.

34. The microscope of claim 29, wherein the focusing system prevents contact between the lens and the object being viewed.

35. The microscope of claim 29, wherein the focusing system comprises:

(i) a focus ring to maneuver the object with respect to the lens; and

(ii) an aperture selection device comprising a plurality of apertures adapted to allow varying amounts of light to enter the structure.

36. The microscope of claim 29, wherein the image is focused by moving the stage along the direction of the optic axis of the lens by a cam and follower mechanism.

37. The microscope of claim 36, wherein the structure comprises a top cover and a bottom cover,

wherein the stage is positioned between the top cover and the bottom cover and further comprises an upper surface and a lower surface, the upper surface providing a surface for viewing and the lower surface comprising a plurality of cam follower elements,

wherein the focus mechanism is positioned between the stage and the bottom cover, and further comprises an upper surface and a lower surface, the upper surface having a plurality of ramped cam surfaces corresponding to the plurality of cam follower elements,

wherein interaction between the cam follower elements and the ramped cam surfaces allows focusing and prevents rocking of the stage.

38. The microscope of claim 36, comprising three cam follower elements.

39. The microscope of claim 1, wherein the lens is selected from the group consisting of a ball lens, a glass ball lens, a double convex lens, a meniscus lens, an aspheric lens, a kino-form-corrected aspheric double convex lens, a kino-form-corrected aspheric meniscus, a flat-field apochromatic single-element simple microscope lens, a plano/spheric convex lens, a plano/aspheric convex lens, a plano/diffractive lens, a plano/diffractive-spheric convex lens, a plano/diffractive-aspheric convex lens, a diffractive plano/spheric convex lens, a diffractive plano/aspheric convex lens, a double convex spheric/spheric lens, a double convex spheric/aspheric lens, a double convex aspheric/aspheric lens, a double convex diffractive-spheric/aspheric lens, a double convex spheric/diffractive-aspheric lens, a double convex aspheric/diffractive-aspheric lens, a double convex diffractive-aspheric/diffractive-aspheric lens, a spheric/spheric meniscus lens, a spheric/aspheric meniscus lens, an aspheric/aspheric meniscus lens, a diffractive/diffractive mensicus lens, a diffractive-spheric/spheric meniscus lens, a diffractive-spheric/diffractive-spheric meniscus lens, a diffractive-spheric/aspheric meniscus lens, a spheric/diffractive-aspheric meniscus lens, an aspheric/diffractive-aspheric meniscus lens, a diffractive-aspheric/diffractive-aspheric meniscus lens, and any combination thereof.

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40. The microscope of claim 39, wherein the lens is fabricated from a gradient refractive or diffractive index material.

41. A microscope support structure, comprising:

(a) one and only one aperture optimized lens;

(b) a slide positioning mechanism; and

(c) a focusing system adapted to focus an image of an object;

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wherein the support structure defines a substantially enclosed space adapted to receive a slide for viewing.

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42. The microscope support structure of claim 41, further comprising:

(i) a top cover supporting the lens; and

(ii) a base adapted to support a microscope slide,

wherein the top cover and the base are at least partially separable from one another in order to allow access to a microscope slide.

43. The microscope support structure of claim 42, wherein the at least partial separability between the top cover and base is provided by a connection means selected from the group consisting of the top cover and base being completely removable from one another, the top cover being adapted to slide off the base, and the top cover and base being hinged, and any combination thereof.

44. The microscope support structure of claim 42, wherein the top cover and base are hinged and wherein the top cover is separated from the base by rotation about the hinge.

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45. The microscope support structure of claim 44, further comprising a coupling mechanism adapted to couple a non-hinged edge of the top cover to a non-hinged edge of the base to provide the substantially enclosed space.

46. The microscope support structure of claim 45, wherein the coupling mechanism is selected from the group consisting of a lock, a catch, a hook and lip mechanism, and finger pressure catches.

47. An enclosed microscope, comprising:

(a) a lens or a plurality of lenses carried by a top cover; and

(b) a stage adapted to position a slide.

48. The microscope of claim 47, wherein the enclosed microscope is a hinged box comprising the top cover and a lower portion, the lower portion housing the stage, a focusing system, a slide holding mechanism, and a slide position locking apparatus.

49. A microscope of claim 47, comprising a plurality of lenses mounted on the top cover, wherein the lenses may be re-positioned in use, with only one lens at a time being used for viewing.

50. The microscope of claim 49, wherein the plurality of lenses are mounted by a carrier comprising a rotatable disk or a sliding member.

51. The microscope of claim 50, further comprising detents on the carrier to provide a positive stop for positioning the plurality of lenses.

52. The microscope of claim 49, wherein the plurality of lenses have different magnifying powers.

53. A pocket-sized microscope comprising a housing supporting a single lens, the microscope having no other lens, the housing adapted to retain and self-contain a microscope slide for viewing and safety.

54. A single lens microscope for viewing objects, comprising:

(a) a structure maintaining an aperture optimized lens; and

(b) a base, comprising:

(i) a slide positioning device,

(ii) a focusing mechanism, and

(iii) a light receiving controller,

wherein the structure and the base are opposable and adapted to at least partially enclose the object being viewed.

55. A microscope comprising an aperture optimized lens for producing a magnified image of a subject, the lens having two surfaces, each of which may be chosen from the group consisting of plano, spherical concave, spherical convex, aspheric concave, and aspheric convex.

56. A method for providing an optimized aperture of a single lens, comprising:

(a) determining the geometrical optics resolution limits of the lens;

(b) determining the diffractive resolution limits of the lens; and

(c) determining a range in which the geometrical optics resolution limits and the diffractive resolution limits meet in order to provide an optimum aperture size.

57. The method of claim 56, wherein the optimizing an aperture of a single lens is performed using computer software.

58. The method of claim 56, wherein the diffractive resolution limit of the lens is the diffractive Rayleigh resolution limit.

59. The method of claim 56, wherein the determining the diffractive resolution limits of the lens comprises performing a Huygen's point spread function analysis to determine the Strehl ratio of the image.

60. The method of claim 59, wherein the range in which the geometrical optics resolution limits and the diffractive resolution limits are substantially equal comprises a Strehl ratio of ~~about~~ 0.8.

61. The method of claim 56, wherein the aperture of the single lens has an aperture size within the range provides a resolution limit within five percent of the optimal resolution limit of the lens.

62. A method for providing an optimized lens aperture, comprising:

(a) providing a lens;

(b) determining a first size range of an aperture wherein light entering or exiting the lens would provide optimized image resolution;

(c) determining a second size range of the aperture wherein the refractive aberration of the lens is minimal in order to compensate for minor deviations in the lens; and

(d) determining a third range within the first and second size ranges wherein a quality image is produced, the range defining an optimized lens aperture.

63. A process for optimizing the aperture of a single lens by minimizing the aggregate impairment of image resolution contributed by refractive aberrations and aperture diffraction, comprising:

(a) selecting an initial aperture size to provide an apertured lens;

(b) determining the numerical aperture of the apertured lens;

(c) determining the diffractive resolution limits for the apertured lens;

(d) determining the geometrical optics resolution limits of the apertured lens;

(e) if the diffractive resolution limit is smaller than the geometrical optics resolution limit, decreasing the size of the aperture and repeating (b)-(e);

(f) if the geometrical optics resolution limit is smaller than the diffractive resolution limit, increase the size of the aperture and repeating (b)-(e);

wherein the aperture is optimized when the diffractive resolution limit and the geometrical optics resolution limit are substantially equal.

64. The process of claim 63, wherein the determining the diffractive resolution limit for the apertured lens comprises performing a Huygen's point spread function analysis to determine the Strehl ratio of the image.

65. The process of claim 64, wherein (e)-(f) further comprise:

(e) if the Strehl ratio is less than 0.8 then (i) the lens aperture size is reduced, (ii) the lens is optimized again to attain best focus, and (iii) the Huygen's point spread function analysis is repeated;

(f) if Strehl ratio is greater than 0.8 then (i) the lens aperture size is increased, (ii) the lens is optimized to attain best focus, and (iii) the Huygen's point spread function analysis is repeated;

wherein the aperture is optimized when the Strehl ratio is equal to 0.8.

66. The process of claim 63, wherein there is an inverse relationship between the lens size and the optimized numerical aperture.

67. A single lens resolution optimization process, comprising:

(a) choosing an initial aperture size;

(b) creating an optical merit function;

(c) setting the focal distance of the lens to be an optimized variable;

(d) bringing the lens to focus;

(e) performing a near-field point spread function analysis to determine the Strehl ratio;

(f) if the Strehl ratio is less than 0.8, reducing the lens aperture size and repeating (c)-(g);

(g) if the Strehl ratio is greater than 0.8, increasing the lens aperture size and repeating (c) -(g);

wherein when the Strehl ratio equals 0.8, the aperture size has been optimized to attain a quality image resolution.

68. The single lens resolution optimization process of claim 67 performed with the aid of optical analysis computer software.

69. The single lens resolution optimization process of claim 67 where (e) is determined using Huygen's point spread function.

70. A process for designing decentration error tolerant aspheric lenses having lens surfaces, comprising:

(a) entering initial lens design criteria into lens design computer software;

(b) adding a coordinate break between the lens surfaces to model the decentration expected from manufacturing tolerance limits;

(c) creating a merit function that includes X and Y effective focal lengths with weighting factors sufficiently large to preserve their desired values;

(d) stepwise optimizing the lens surfaces even asphere function coefficients; and

(e) applying aperture optimization methods to attain best image resolution.

71. The process of claim 70 wherein the lens design computer software is Zemax.

72. The process of claim 70, further comprising:

(f) optimizing the lens across all surface parameters simultaneously until no substantial improvement in performance is attained; and

(g) again applying aperture optimization methods to attain best image resolution.

a)

73. The process of claim 72, wherein the optimizing the lens across all surface parameters comprises using Hammer Optimization or Global Optimization or both.

74. The process of claim 70, wherein the aperture optimization methods comprise:

(a) determining the geometrical optics resolution limits of the lens;

(b) determining the diffractive resolution limits of the lens; and

(c) determining a range in which the geometrical optics resolution limits and the diffractive resolution limits are substantially equal in order to provide an optimum aperture size.

75. The method of claim 70, further comprising optimizing diffractive surface parameters.

76. A process for optimizing diffractive surface parameters of a lens, comprising:

(a) making focal distance variable;

(b) stepwise optimizing diffractive coefficients on a first surface, beginning with the lowest order coefficient;

(c) if the period/mm of the diffractive surface does not exceed the tooling limit, the process for the first surface is complete;

(d) if the period/mm of the first diffractive surface exceeds the tooling limit, eliminate the highest order diffractive surface coefficient and optimize the remaining diffractive surface coefficients;

(e) repeating (d) until the period/mm of the first diffractive surface does not exceed the tooling limit.

77. The process of claim 76, further comprising performing (a)-(e) on a second surface.

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